Dichotic Word Recognition for Young Adults with Normal Hearing

Jennifer L. Bournique, Academic Advisor: Christina M. Roup, Ph.D.
Department of Speech & Hearing Science

Richard J. & Martha D. Denman
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ABSTRACT

The purpose of this study was to measure dichotic word recognition at various intensity levels in order to produce a performance-intensity (PI) function that modeled the data. For any test that requires a behavioral response from a listener, such as a dichotic listening task, it is important to understand the relationship between the stimulus and the responses given. One way of characterizing this relationship is by generating a psychometric function, or in the case of speech recognition, a PI function. These functions display percentage of correct responses as a function of intensity in dB HL. The purpose of this study was to create a PI function based on the dichotic listening results from normal hearing young adults. The present study attempted to determine if the slope and threshold characteristics of the PI functions for dichotic listening differed between right and left ears as well as from that of monaural listening PI functions. Ten young adults with normal hearing were recruited to participate in the present study. Dichotic word recognition performance was measured at six different intensity levels. The results indicated a significant difference in the slope of the PI function between the right and left ears, whereas no significant difference in threshold was observed between the right and left ears. The overall shape of the dichotic PI functions is similar to that of monaural PI functions. In contrast, both slope and threshold characteristics of dichotic PI functions differed from monaural PI functions. Specifically, dichotic PI function slopes were shallower and thresholds were higher when compared to monaural functions.

INTRODUCTION

DICHOTIC SPEECH RECOGNITION

- Dichotic listening refers to the condition in which two competing messages are presented simultaneously, one message to each ear.
- The task of the subject is to recall both the words he or she hears.
- Dichotic listening tasks are used clinically to test auditory processing abilities in children and adults.

MONAURAL PERFORMANCE-INTENSITY (PI) FUNCTIONS

- Psychometric functions are used to show the relationship between the stimulus and its response from the subject.
- A PI function describes the relationship between the intensity (in dB HL) of a speech stimulus and the performance (in percent) of the listener. Performance is plotted on the ordinate and intensity on the abscissa.
- Wilson et al. (1990) found monaural PI functions using the NU-6 word list to have a slope of 4.5 %/dB and a 50%-correct threshold between 16 and 20 dB HL for young adults with normal hearing.

THE PRESENT STUDY

- The purpose of this study was to create a PI function for a dichotic listening task.
- The PI function for dichotic listening will be compared to PI functions for monaural listening tasks.
- Performance characteristics of the PI function for the right ear will be compared to that of the left ear.

METHODS

SUBJECTS

- 10 young adults (3 males, 7 females) participated
- Age Range: 19 – 24 years
- Inclusion criteria included:
  - Native speakers of English
  - Right handedness as determined by Edinburgh Handedness Inventory; score of ≤ 20 (Oldfield, 1971)
  - Normal otoscopy and tympanometry
  - Normal hearing, defined as pure tone thresholds ≤ 20 dB HL 250 – 8000 Hz and no air-bone gaps 500-4000 Hz

MATERIALS

- 200 monosyllabic words from the Northwestern University Test No. 6 (NU-6) paired into 100 dichotic word pairs
  - Dichotic word pairs were grouped in lists of 25
  - 12 randomizations of the lists were created to minimize list effects
- Spoken by a female speaker
- Each word pair included the carrier phrase “say the word”

PROCEDURES

- Dichotic word recognition was measured at six intensity levels:
  - 8, 16, 24, 32, 40, and 48 dB HL
- Several practice items were given to make sure each subject understood the task.
- Each subject was presented with two lists at each intensity level, once during an ascending run and once during a descending run:
  - 5 subjects began testing with an ascending run followed by a descending run.
  - 5 subjects began testing with a descending run followed by an ascending run.
- Subjects were required to recall both words they heard in a free-recall response format (i.e., any order).
- No feedback was given as subjects completed the task, although encouragement was provided.
- Testing took place in a sound-proof booth and all equipment was calibrated according to ANSI standards (ANSI, 1987, 2004).

RESULTS

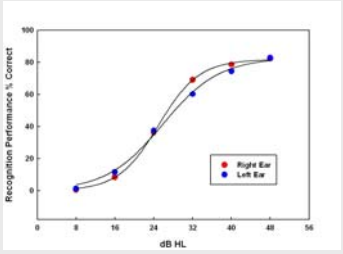

Figure 1. PI functions for the right and left ears

- The slope of the PI function for the right ear (3.05%/dB) was significantly steeper than the slope of the PI function for the left ear (2.64%/dB).
- The 50%-correct thresholds for the right (28.76 dB HL) and left ear (29.66 dB HL) were not significantly different.
- A right-ear advantage occurred at 32 and 40 dB HL, and a left-ear advantage occurred at 8, 16, 24, and 48 dB HL.
- Overall, subjects reached their 50%-correct threshold at around the same intensity level for both ears, but reached their maximum performance more rapidly in the right ear.

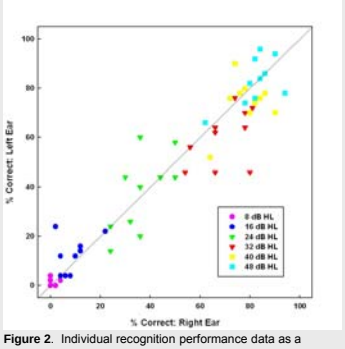

Figure 2. Individual recognition performance data as a scatter plot. Points falling below the line represent instances where performance was better in the right ear. Points above the line indicate better performance in the left ear.

- Performance was less variable at the lowest and highest intensity levels where subjects were performing consistently very poorly or very well.

SUMMARY & CONCLUSIONS

DICHOTIC vs. MONAURAL PI FUNCTIONS

- The s-shape of the dichotic PI function was typical of PI functions from monaural listening tasks using the same NU-6 word lists (Wilson et al., 1990).
- The slope of the PI functions for both right and left ears were less steep than those of monaural listening tasks (Wilson et al., 1990).
- The 50%-correct thresholds for the right and left ear PI functions occurred at higher intensity levels than in similar monaural listening tasks (Wilson et al., 1990).
- The differences in both slope and threshold noted between dichotic and monaural PI functions may be due to the increased difficulty of dichotic listening tasks when compared to monaural listening tasks.

RIGHT vs. LEFT DICHOTIC PI FUNCTIONS

- The 50%-correct thresholds of the right (28.76 dB HL) and left ears (29.66 dB HL) were not significantly different.
- The slope of the PI function for the right ear (3.05 %/dB) was significantly steeper than the slope of the PI function for the left ear (2.64 %/dB).
- The difference in slope observed between ears may be consistent with the right-ear advantage typically found in studies of dichotic listening (Wilson & Leigh, 1996; Strouse & Wilson, 1999) because the right ear reaches maximum performance before the left ear does.
- Interestingly, mean data at most intensity levels are not consistent with a right-ear advantage. This may suggest that the right-ear has a greater advantage at some intensities than at others, specifically intensities that occur over an individual’s 50%-correct threshold.

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